Irrigation Practices and How They Affect Pesticide Leaching to Ground Water

Irrigated agriculture is the largest user of freshwater in Montana. According to water use data for the year 2000 (Hutson et al., 2004) approximately 8.9 million acre-feet of water was used on 1.7 million acres of irrigated land. Of these irrigated acres, approximately 506,000 acres were under sprinkler irrigation while 1.22 million acres consisted of surface irrigation.

Irrigation makes up for water deficits in the dry areas of Montana where precipitation is scarce. Most irrigation water is stored in soils and taken up by plants or evaporated, however, some water usually passes through the crop root zone and can percolate down to ground water. When irrigation water passes out of the crop root zone it can leach pesticide residues with it, leading to groundwater impacts. This is particularly true in Montana where irrigation generally occurs in areas with shallow ground water, which is vulnerable to pesticide impacts. Shallow wells (<50 feet) screened in unconsolidated aquifers in areas of irrigated crops are nearly twice as likely to be contaminated with pesticide residues than shallow wells in non-irrigated areas (Barbash and Resek, 1996). Generally, the leaching risk for different irrigation systems, from high risk to low risk, follows the order furrow>basin>sprinkler. Since approximately 70% of the irrigation in Montana is furrow and basin (flood) irrigation and ground water in these areas is generally shallow, it follows that ground water is vulnerable to pesticide impacts in irrigated agricultural areas.

Irrigated fields lose water through evaporation, drift, runoff, or deep percolation. These loses reduce the efficiency of the irrigation application. In general, sprinkler systems tend to be more efficient than surface (basin or furrow) irrigation systems (Watts, et al., and Miller, 2005). Water loses are generally high under surface or flood irrigation systems due to deep percolation of water below the crop root zone and water runoff at the end of the field. Water lost to deep percolation from surface irrigation can leach pesticides to ground water, as can field runoff water if it is allowed to percolate into the ground. Field runoff that is collected in a wastewater ditch can also leak from the ditch, into the surrounding soils, and leach pesticides that were dissolved during irrigation. Sprinkler systems will generally lose considerably less water due to deep percolation than surface irrigated systems. This does not mean, however, there is no risk for leaching pesticides to ground water under sprinkler irrigated fields, even if irrigation is done in an efficient manner. Over-irrigation, or irrigating beyond the field capacity of the soil, is a common practice. Over-irrigation or inefficient irrigation leads to excessive deep percolation and surface runoff of excess water. This in turn leads to possible ground water and surface water impacts.

The timing of irrigation after pesticide application also plays a large role in pesticide leaching. The greatest losses of pesticide will occur during the first irrigation or rainfall event after application. The amount of this loss will decrease with every day that passes between application and irrigation or rainfall.

This is because the extra time will give the pesticide time to degrade, bind to soil particles, or be removed from the soil. In other words, the amount of pesticide available for leaching to ground water will be less. Even a single day can make a large difference.

Best Management Practices to Protect Ground Water Near Irrigated Crops:

1) Manage irrigation by knowing how much water needs to be applied.
2) Adjust application amounts based on the crop demands at different stages of growth.
3) Schedule irrigations based on the soil moisture and crop water use.
4) Apply irrigation water uniformly and accurately.
5) Delay irrigation as long as possible following pesticide application.
6) Schedule last irrigation of the season so that soil moisture is at a minimum in the fall. This provides storage in the soil for off-season precipitation and minimizes pesticide leaching during the spring.
7) Use pesticides that are less likely to leach.

Educational materials concerning irrigation management along with numerous other agricultural topics can be obtained from the Montana State University (MSU) Extension Service (http://www.montana.edu/wwwpb/pubs/indexag.html or contact your MSU County Extension Agent) or from the MSU Extension Water Quality Program (http://waterquality.montana.edu).

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